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14. ABSTRACT
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15. SUBJECT TERMS
Marmara Sea, air-sea interactions, wind/font, circulation, atmospheric input

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EVALUATION OF WIND FIELD PREDICTIONS BY ATMOSPHERIC MODELS OVER THE MARMARA SEA

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Abstract

Data collected from meteorological stations in the Turkish Straits System around the Marmara Sea are used to assess the performance of atmospheric models in predicting the winds. The Coupled Ocean/Atmosphere Mesoscale Prediction System, COAMPS is applied using different spatial resolutions ranging between 1 km and 27 km to investigate the effect of model spatial grid resolution on accuracy of the computed wind field. The influence of the ocean dynamics on the atmospheric winds is also investigated by comparing wind field predictions from a fully coupled COAMPS with those from the uncoupled (stand-alone atmospheric) COAMPS. Following the examination of the wind products, the importance of using high resolution wind forcing for ocean circulation predictions is evaluated.

Keywords: Marmara Sea, Air-Sea Interactions, Wind/Font, Circulation, Atmospheric Input

The Turkish Straits System (TSS) contains the Dardanelles and the Bosphorus straits that connect the Marmara Sea to the Aegean and the Black Seas, respectively. Fresh, light Black Sea water flows at the surface towards the Aegean Sea while saline, dense Mediterranean water flows deep in the opposite direction resulting in a two-layer stratified flow in both straits. Winds over the region play a major role in generating various features within the TSS system, i.e. blocking of the deep (surface) flow within the straits by Northerly (Southerly) winds; the spread of the Dardanelles outflow plume over the Aegean Sea; and the circulation pattern within the Marmara Sea among the others. Since the winds are the dominant external forcing applied to the ocean models, accurate predictions of winds by atmospheric models are crucial for accurate predictions of the flow dynamics.

Hourly wind direction and speed data collected from 13 meteorological stations located around the Marmara Sea between May 2008 and June 2009 are used to assess the performance of atmospheric models in predicting winds. The measurements recorded every ten minutes by two Meteo-buoys on the Marmara and Black Seas are also included in the evaluation. The atmospheric models under consideration are the Coupled Ocean/Atmosphere Mesoscale Prediction System, COAMPS [1], and the numerical weather prediction model, COSMO-ME, based on the non-hydrostatic Lokall-Model(LM) [2]. COSMO is the COnsortium for Small scale MOdeling and COSMO-ME is a particular application running on the Southern Europe/Mediterranean Sea domain managed by USAM (Meteorological Service of the Italian AirForce). It has a spatial resolution of 7-km while COAMPS has a coarse operational grid resolution of 27-km. Local configurations of the COAMPS model for grids of 9-km, 3-km and 1-km are also considered.

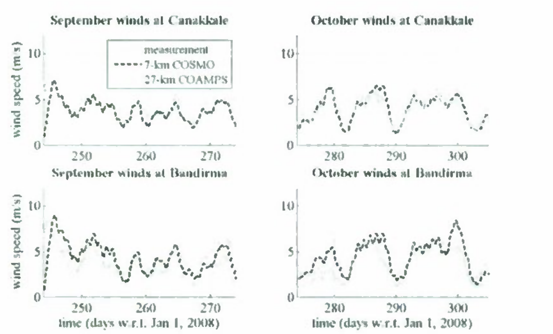

Fig. 1. Wind speed variation (36-hour averaged) over September and October 2008 at Canakkale and Bandirma meteorological station locations: Measurements (solid), 7-km COSMO model results (dash) and 27-km COAMPS model results (dot).

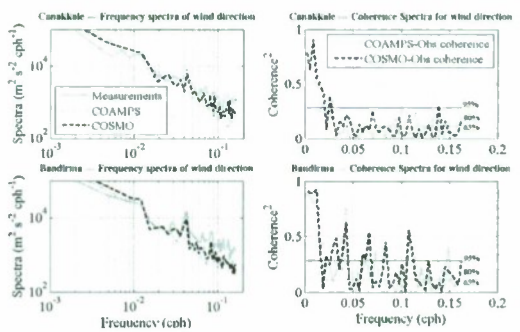

Fig. 2. Frequency and coherence spectra of wind direction measurements vs. the COAMPS (27-km) and COSMO (7-km) model results for Canakkale and Bandirma meteorological stations.

Both model inter-comparisons (COAMPS vs. COSMO) and model-data comparisons are conducted. Model-data comparisons consider both the raw and filtered time series of wind speed and direction. A more detailed statistical analysis is done by examining the frequency spectra of the modeled and measured wind fields and the coherence between them. The coarser COAMPS model is able to capture the low-frequency (36-hour averaged) wind speed variability as shown in Fig. 1. COAMPS-COSMO comparisons indicate similar wind field predictions (shown in Fig.1) with the exception of wind direction during higher frequency wind events such as the semi-diurnal cycle or the land/sea breeze events as shown in Fig. 2.

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